

REMARKS

Favorable reconsideration of this application is requested in view of the foregoing amendments and the following remarks. Claims 1-7, 9-10, 12, 14-16, 18 and 20-21, 23-31, 33-40 and 42-62 are pending in the application. Claims 8, 11, 13, 17, 19, 22, 32, 36 and 41 were previously cancelled without prejudice or disclaimer.

The claims are now further amended in order to more clearly define the invention, support for which is found in the figures and related parts of the specification. Support for the recitation of "to improve a quality of pilot position estimation is found at line 9, page 18 of the specification as originally filed.

A second executed Declaration under 37 CFR 1.132 that provides indicia of nonobviousness having a strong nexus with the presently claimed invention is being filed herewith. Although the second Declaration can speak for itself, it is noted that the Declaration enters most of the following remarks as evidence of record. Applicant requests that the Office acknowledge receiving this second Declaration.

Claims 1-7, 9-10, 12, 14-16, 18, 20-21, 23-31, 33-40 and 42-62 are rejected as obvious over Naden et al U.S. Patent No. 5,999,561 (hereinafter Naden) in view of Higuchi et al. U.S. Pat. No. 6,167,037 (hereinafter Higuchi). This rejection is untenable.

The claims were previously amended to require correlation values between the digital signal {s(n)} and at least one locally generated version of I-channel and Q-channel PN signals {I_{PN}(n)} and {Q_{PN}(n)} averaged over multiple periods of the PN signals. This limitation was extensively explained in the previous response. The Office Action does not acknowledge this previous amendment. Applicant requests that the Office allow this application or address this amended limitation.

An executed Declaration under 37 CFR 1.132 was previously filed to make numerous technical arguments evidence of record, including the important limitation of correlation values

between the digital signal {s(n)} and at least one locally generated version of I-channel and Q-channel PN signals $\{I_{PN}(n)\}$ and $\{Q_{PN}(n)\}$ averaged over multiple periods of the PN signals. The Office Action does not acknowledge the previously filed executed Declaration under 37 CFR 1.132 or address the numerous technical arguments contained therein that are now of record. Applicant requests that the Office acknowledge receiving this first Declaration.

Both the previously filed response and the previously filed Declaration under 37 CFR 1.132 explain in detail why the Higuchi reference actually teaches away from the claimed invention. The Office Action does not address this line of reasoning. Applicant requests that the Office allow this application or address this line of reasoning.

The Office Action states that "Higuchi teaches correlation values are averaged over plurality of long codes" citing Higuchi col. 14, lines 1-13. However, this is insufficient because Higuchi does not disclose or suggest averaging correlation values between the signal and the long code itself over multiple periods of the long code. All the independent claims specify what is being correlated as well as over what period they are being correlated. Both limitations are part of the claimed invention.

To reiterate, all of independent claims 1, 14, 23, 24 and 34 were previously amended to require that the present invention's correlation values that are averaged over multiple periods of the PN signals (e.g., long code) are between the signal and the long code itself. This important limitation is explicitly recited in independent claims 1, 14 and 23 as "over multiple periods of the PN signals." This important limitation is similarly explicitly recited in independent claims 24 and 34 as "over multiple periods of the chip-rate PN sequence." **Higuchi simply does not disclose or suggest averaging correlations between a signal and the long code itself.** This will be explained again in more detail in the following paragraphs of these remarks.

IS-95 CDMA, as practiced in North America and elsewhere is indeed a form of DS-CDMA where multiple spreading codes are employed (see Higuchi col. 1, lines 26-35). In particular, a 64-length Gold code is the "short code" with period equal to that of an information

symbol (bit). This "short code" can be used to separate channels of information (each user would use one channel). PN codes length $2^{15} = 32768$ are superimposed (there are two, specifically, a first for the I channel and a second for the Q channel) and these, together are referred to as the "long code" by Higuchi, can be used to distinguish base stations. In IS-95 CDMA, all base stations use the same long code but each base station uses a different time offset (thus base stations are distinguished by their time offset).

Higuchi (and Naden) are concerned with a DS-CDMA receiver, and thus are primarily concerned with data (information) extraction. Synchronization for both Higuchi and Naden, in terms of establishing the start of the spreading code is vital for data extraction and must be done in the case of Higuchi and Naden both rapidly and with enough accuracy to reliably extract the data (information). In contradistinction to both Higuchi and Naden, the claimed invention is directed to a measurement methodology that is concerned with making a very precise and accurate estimate of the start of the spreading code that is completely independent of a need to extract data; the claimed invention (this estimation) can be done over intervals of time much longer than the symbol interval.

Higuchi is concerned with acquisition and more importantly the need to acquire code synchronization in a rapid manner (see Higuchi col. 3, lines 33-65). To this end, Higuchi proposes masking the second code group for M (≥ 1) symbols at fixed intervals (see col. 4 lines 12-17 and Claim 1). As is clear from Higuchi Fig. 15 and Fig. 7, the correlation is performed between the input signal *and the short code*. Clearly this correlation can be done only in the window of M symbols while the long code is masked. Higuchi recites the need for introducing this window where the long code is masked at the same point in each long code period and thus the statement in Higuchi at col. 14, lines 3-5 "... as shown in Fig. 15 (correlation values are also available which are obtained by averaging over a plurality of long code periods),..." necessarily implies that the averaging of Higuchi, if done at all, is done of the correlation values obtained over M symbols (the masking interval) in consecutive long code periods. Considering

that this is being done by Higuchi in the acquisition phase and so the local time-base has not yet been synchronized to the transmitter time-base, it is unlikely that averaging over many periods will be beneficial; in fact averaging over many long code intervals is contraindicated by Higuchi.

Thus, it is thus very clear that while Higuchi teaches that averaging during a plurality of long code time periods may be employed, **every one of Higuchi's averaged correlations is between the short code and the input signal because they are constructed during intervals when the long code is masked and unavailable to Higuchi.** Therefore, Higuchi teaches away from the presently claimed invention that includes averaging a correlation between a signal and the long code itself.

In IS-95 CDMA, an arena to which embodiments of the invention may be directed, there is no masking interval for the “long code” (i.e., both the I PN sequence and the Q PN sequence are continuous with no gaps). This Application teaches embodiments including the generation of correlations using a pilot channel. The Gold code for the pilot channel is typically the null code (all 1s) which has no useful correlation properties with the input signal, especially considering that the long code is not masked in IS-95 CDMA. Therefore averaging over a plurality of long code periods of the correlation between the short code and the input signal as might be suggested by Higuchi has no bearing on the IS-95 CDMA embodiments of this invention.

What Higuchi does not describe or teach is the notion of averaging, over a plurality of long code periods, the correlation between the long code and the input signal. In fact, when correlation between the long code and the input signal is calculated by Higuchi, it is evident from Fig. 16 (and Fig. 17, and Fig. 18) that Higuchi reverts back to the conventional tracking receiver such as taught by Naden.

Naden teaches a methodology for DSSS (Direct Sequence Spread Spectrum) terminals. Naden teaches a DSSS receiver that is of the tracking variety. That is, a continuous monitoring

and estimation of correlation must be made by Naden *on the channel being used for communication.* The Naden correlation must be made for “early”, “late”, and “on-time”. Naden actually uses four “early” and four “late” estimates corresponding to time-offsets of (1/4), (1/2), (3/4), and (1) chips. Furthermore, the tracking aspect of the Naden receiver mandates that these four estimates be done for *each period* of the spreading code and Naden must dwell on his single spreading code 100% of the time. The Naden reference does not disclose or suggest averaging over multiple code periods.

In general, Naden’s teachings relate to a *DSSS radio with the emphasis on communications* and the attendant need for low power, long battery life, power management, and such attributes. In sharp contrast, the claimed invention is closer to the notion of a *measurement instrument* that monitors radio transmission and extracts the information necessary to discipline a high quality oscillator such as a Rubidium Atomic Standard or high performance oven controlled crystal oscillator (“OCXO”).

With regard to claims 44-47, these embodiments of the claimed invention require averaging C_{MS} over multiple correlation computations in order to reduce the impact of any extraneous signal.” This embodiment of the invention can provide the significant advantage of reducing the impact of an extraneous signal. Thus, dependent claims 44-47 are each considered to be separately patentable.

With regard to claims 48-49 and 51-52, these embodiments of the claimed invention require synthesizing an offset to improve precision of an estimate of time-of-arrival of a received pilot code based on a ratio of i) a sum of correlation values prior to on-time to ii) a sum of correlation values after on-time. These embodiments of the invention can correlate lags smaller than the sampling interval by interpolation. These embodiments of the invention can provide a finer grain of lags than the $4f_c$ (where f_c is the chip rate) sampling interval of Naden. Referring to the first full paragraph of page 27 of this application as originally filed, a specific algorithm for

implementing this embodiment of the invention is described. Thus, dependent claims 48-49 and 51-52 are each considered to be separately patentable.

With regard to claims 20, 43 and 53-58, these embodiments of the claimed invention require tracking multiple pilots. Referring to the first sentence of the last full paragraph of page 20 of this application as originally filed, it is stated that “[b]y using multiple correlators in parallel, or by ‘time-sharing’ correlators, multiple pilots can be tracked. This embodiment of the invention provides significant advantages when multiple pilots are available. Naden’s architecture can work only with a single channel, corresponding to a channel being used for communication. Therefore, Naden teaches away from these embodiments of the claimed invention. The ‘time-sharing’ embodiments of claims 55-58 do not “dwell” on a pilot channel 100% of the time but can observe it for a while and then come back to it later by remembering the (approximate) location of time-of-arrival relative to the local counter. This is facilitated by the doing several correlation lags just in case the “on-time” location has moved, which it could if the local time-base is offset somewhat from the transmitter time-base. Thus, dependent claims 20, 43 and 53-58 are each considered to be separately patentable.

With regard to claims 59-62, these embodiments of the claimed invention require the use of *different PN codes for the I and Q channels*, requiring the receiver to do likewise. In sharp contrast, Naden teaches a receiver that can only be used with a single PN code. Naden teaches a conventional DSSS radio architecture whereby the phase difference between the local oscillator and the remote transmitter is rendered moot by applying the disspreading code to both I and Q channels. This is emphasized by Fig. 11 of Naden which shows a single PN code generator (1120) that is applied to both the I and Q channels. Thus, dependent claims 59-62 are each considered to be separately patentable.

Accordingly, withdrawal of this rejection is respectfully requested.

Claims 1, 14, 23-24 and 34 are rejected as obvious over Naden et al U.S. Patent No. 5,999,561 (hereinafter Naden) in view of Schoolcraft U.S. Pat. No. 5,999,561 (hereinafter Schoolcraft). This rejection is untenable.

The Schoolcraft reference teaches a method to "intelligently combine" the correlation peaks in order to get a better signal-to-noise ratios for data extraction. The Schoolcraft reference does not obviate the above-discussed deficiencies of the Naden reference (or the Higuchi reference). **Schoolcraft simply does not disclose or suggest averaging correlations between a signal and the long code itself.**

In order to recognize the distinctions between the claimed invention and the prior art that the Examiner has cited (e.g. Naden 5,999,561; Higuchi 6,167,037; Schoolcraft 5,237,587) it is important to recognize the context in which the invention is applied.

Higuchi (and Naden and Schoolcraft) are concerned with a *DS-CDMA receiver used for communication and thus are primarily concerned with data (information) extraction*. The above-identified application describes methodology better suited for *measurement of the time-of-arrival of the (starting point of the) spreading code relative to a local clock*.

In conventional receivers, primarily from cost-of-goods criteria, the oscillator used will be, typically, a quartz resonator. In the application area of the claimed invention, the oscillator quality will be much higher, typically a rubidium secondary atomic standard. The implications of this statement will become apparent shortly.

Synchronization for both Higuchi and Naden, in terms of establishing the start of the spreading code is vital for data extraction and must be done in the case of Higuchi and Naden both rapidly and with enough accuracy to reliably extract the data (information). This implies that the receiver must be agile enough to follow multi-path. Furthermore, it is advantageous for Naden (and Higuchi) to determine the strongest multipath component. Schemes, referred to as "rake receivers" in the literature can be implemented to use multiple multipath components to improve the quality of data extraction (e.g. Schoolcraft). In contradistinction to both Higuchi and

Naden, the claimed invention is directed to a measurement methodology that is concerned with making a very precise and accurate estimate of the start of the spreading code that is completely independent of a need to extract data; the claimed invention (this estimation) can be done over intervals of time much longer than the symbol interval. Furthermore, of specific interest is the “earliest arrival” which corresponds, in all likelihood, to the most direct path between the transmitter and receiver. It should be noted that the “earliest arrival” may not be the one with the most signal strength.

Higuchi teaches the determination of the dominant correlation peak by “searching” around the expected arrival time. The intent is to maximize signal-to-noise ratio for data extraction. In contradistinction, the claimed invention determines the correlation values for time-offsets around the expected arrival time to establish whether the “earliest arrival” (typically, but not always, the dominant correlation peak) has moved with respect to the local clock; the intent is to see whether the time-base of the transmitter is different from the time-base of the receiver. In rake receiver methodology the multiple correlation peaks are “intelligently combined” (e.g. Schoolcraft) to improve the effective signal-to-noise ratio in order to get more robust data extraction. In contradistinction, the claimed invention utilizes the multiple correlation peaks to estimate a more precise time-of-arrival of the “earliest arrival”.

Since Higuchi (and Naden and Schoolcraft) are interested in continuous data extraction, they must track the time-of-arrival of the dominant (and other multi-path signals if rake techniques are employed) signal *continuously*. Consequently the disciplining of the local oscillator must be of the phase-locked-loop variety. This, in conjunction with the notion of an inexpensive oscillator, implies that averaging, if any, can be done only over a limited period of time. In contradistinction, the claimed invention, since it is only looking for a measurement often enough to discipline the high quality (typically rubidium secondary atomic standard) oscillator, can afford to have “gaps” in its observation pattern. That is, it can observe a pilot signal for a period of time while it is doing the averaging, develop an estimate of time-of-arrival

with respect to its local clock, and then "ignore" the pilot signal for a period of time. The stability of the local oscillator allows this to work, because the "expected time of arrival" will not have shifted by much. The disciplining of the rubidium oscillator is based on frequency-locked loop methods (because of the possibility of "gaps" in the measurement process).

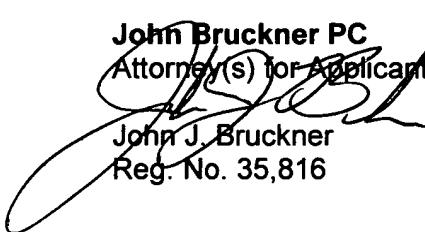
Accordingly, withdrawal of this rejection is respectfully requested.

Other than as explicitly set forth above, this reply does not include acquiescence to statements in the Office Action. In view of the above, all the claims are considered patentable and allowance of all the claims is respectfully requested. The Examiner is invited to telephone the undersigned (at direct line 512-394-0118) for prompt action in the event any issues remain.

In accordance with 37 CFR 1.136(a) pertaining to patent application processing fees, Applicant requests an extension of time from March 28, 2005 to May 28, 2005 in which to respond to the Office Action dated December 28, 2004. A notification of extension of time is filed herewith.

The Director of the U.S. Patent and Trademark Office is hereby authorized to charge any fees or credit any overpayments to Deposit Account No. 50-3204 of John Bruckner PC.

Respectfully submitted,


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